PHYSICS 3140 ENVIRONMENTAL PHYSICS Fall 2010

Syllabus & Course Outline

Instructor: Dr. Richard O. Gray email: grayro@appstate.edu

Office: CAP 311/313, Telephone: 262-2430; Lab: CAP 324

Office Hours: Tuesday & Thursday 2:15 - 3:15 pm.
These are my official office hours for this class, but I maintain an "open-door" policy which means that you are welcome to drop in at times other than listed above.

Textbook: There is one required text for this course, "A Climate Modelling Primer, 3rd edition" by McGuffie and Henderson-Sellers. That text is a supplement for the lecture notes which will be handed out in class on a weekly basis. Another excellent resource is the Intergovernmental Panel on Climate Change's Report "Climate Change 2007: The Physical Science Basis". This may be obtained at http://www.ipcc.ch/ipccreports/assessments-reports.htm

Class meeting: Tuesday & Thursday 1:00 - 2:15 p.m., CAP 108

Web Site: This course has its own web site! Point your browser to http://www1.appstate.edu/dept/physics/ep.html

Evaluation: Two in-class exams will be given over the lecture material. These exams will count for 20.0% of the total grade each. The exams will involve short answer or short essay questions, with possible simple mathematical problems. A final exam will be given at the end of the semester (20% of the grade) and one project on an environmental physics topic (see below) will be required. This project will constitute 20% of the grade. Homework will also be assigned weekly. This homework will count for 20% of the grade. I encourage class participation and discussion, which is what really makes this class interesting and the amount that you contribute to the class in this way will count, somewhat subjectively, in your grade evaluation.

Extra Credit: A number of the best projects will be chosen to be presented to the class. These presentations will earn extra credit for the presenters.

Attendance: Attendance in class is very important, as most class material will come from the lecture or class assignments and discussion. However, attendance will not be monitored in a formal way unless it turns out to be necessary.

This class is being offered to respond to the growing need for knowledge about the physics behind contemporary environmental problems. The lectures will concentrate on the physics of one of the most pressing global environmental problems of the day - the threat of global climate change due to increased greenhouse gases in the earth's atmosphere. We will also examine the ozone depletion problem, alternative energy sources, such as solar and wind power, and environmental issues associated with nuclear power. Environmental Physics is by its nature cross-disciplinary, as it draws on data and insights from diverse fields such as astronomy, chemistry, geology and biology, and its results are of fundamental importance to the future of society.

We will have 28 class meetings during this semester. The proposed schedule (below) will be supplemented by presentations of some of the best term papers.

Lecture	Topic
1	Introduction
Part I	Electromagnetic Radiation and Planetary Atmospheres
2	The nature of light: Wavelength and energy, the electromagnetic spectrum, blackbody radiation
3	Atomic spectroscopy; Kirchoff's laws
4	Molecular spectroscopy
5	Albedo and Planetary Temperatures
6	The effect of an atmosphere: greenhouse gases, IR radiation and the greenhouse effect; energy balance models & feedback effects.
7	Guest lecture: Dr. Jim Sherman, The Appalair project.
8	UV radiation, the ozone layer and ozone depletion.
Part II	The Origin of Planetary Atmospheres
9	The origin of the solar system and the origin of the atmospheres of the terrestrial planets
10	Modification of the atmospheres of the terrestrial planets; comparative study of Venus, Earth, Mars
11	Exam
12	Paleoclimate of the Earth: The causes of the Ice Ages
Part III	Greenhouse Gases and Global climate change on Earth

13 Anthropogenic CO_2 and other greenhouse gases, evidence for increase in the atmosphere
14 The Carbon cycle
15 Aerosols. Intro to Global Climate modeling
16 Physical principles involved in climate modeling
1) Radiative Forcing and Atmospheric Structure
17 2) Atmospheric structure and global circulation
18 3) The Ocean, and the Thermohaline circulation
19 The temperature history of the Earth. Global climate model predictions in general.
20 Exam
21 Global Climate (Circulation) models & predictions
22 IPCC reports: Greenhouse gas emission scenarios and resulting climate predictions. Reliability of climate predictions. Other possible drivers of climate change.

Part V Mitigation of Global Climate Change

23 Fossil fuels and energy supply options; the Kyoto protocol; Copenhagen; future international agreements?
24 Is Nuclear energy a viable energy source??
25 - 26 Alternative energy sources: Hydropower, Biomass, Wind, Solar and Geothermal

Lectures 27 – 28 will be devoted to other environmental physics issues or a more in-depth treatment of some of the topics already covered. These class sessions will be partly or wholly based on term-paper or project presentations.

Important dates (some of these are tentative)
Turn in abstract for your project: September 16
Exam #1: Tuesday, September 28
Exam #2: November 2
Projects Due: November 23
Final Exam: Wednesday, Dec 8, 2009: Noon - 2:30pm

Projects: Each student will be expected to complete a project on some topic relevant to environmental physics during the semester. This project may either be a term paper on an approved topic (see the list below) or a project. Term papers will involve research from primary and secondary sources and should be at least 15 pages long, with 1.5 spacing and 12pt font. Illustrations, figures and references can be included in the 15 pages. Term papers will be graded on content, but also on organization, originality and grammar!

The projects, on the other hand, can encompass any number of activities. For instance, there are simple solar projects that one can carry out easily and cheaply to supplement heating in your home or apartment. Students who are good computer programmers may wish to tackle writing a simple computer climate

model (see your textbook), or simulating the carbon cycle. A survey of energy usage in a selected building on campus, along with suggestions for better energy efficiency is another possible project. A project on aspects of renewable energy in the local area is another possibility. Many people, for one reason or the other, in past classes have built solar ovens. Any such solar thermal project will have to be accompanied by physically valid tests to characterize the device. If you have an idea for a project, come to me and discuss it. All projects should be accompanied by a short (3 - 5) page report with photographs (if applicable). Students can work in groups on a project, provided that the team supplies, at the end, a signed document stating that each team member contributed a roughly equal amount. Team projects will necessarily be in more depth and/or larger than a typical individual project. Projects are preferable to term papers. An abstract or short description of your project or paper is due on Sept 16.

Some possible term paper subjects (others are possible - check with me first)

- Solar variability and the earth's climate
- The Montreal Protocol and the phase-out of Ozone-depleting chemicals
- Ocean circulation and global climate change
- Paleoclimate and the sensitivity of climate to CO_2 concentrations.
- The case for electric vehicles
- Hybrid vehicles
- Progress and problems in the storage of nuclear waste
- Advances in solar energy
- What promise nuclear fusion?
- Geothermal Energy
- Practical ways ASU can conserve energy
- CO_2 concentrations and the Ice Ages
- Fuel Cells & the Hydrogen economy
- Snowball Earth

OTHER Matters:

Academic Integrity *Code:* *As a community of learners at Appalachian State University, we must create an atmosphere of honesty, fairness, and responsibility, without which we cannot earn the trust and respect of each other. Furthermore, we recognize that academic dishonesty detracts from the value of an Appalachian degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form and will oppose any instance of academic dishonesty. This course will follow the provisions of the Academic Integrity Code, which can be found on the Office of Student Conduct Web Site: www.studentconduct.appstate.edu.*

Accommodations for Students with Disabilities: *Appalachian State University is committed to making reasonable accommodations for individuals with documented qualifying disabilities in accordance with the Americans with Disabilities Act of 1990, and Section 504 of the Rehabilitation Act of 1973. If you have a disability and may need reasonable accommodations in order to have equal access to the University's courses, programs and activities, please contact the Office of Disability Services (828.262.3056 or www.ods.appstate.edu). Once registration is complete, individuals will meet with ODS staff to discuss eligibility and appropriate accommodations.*